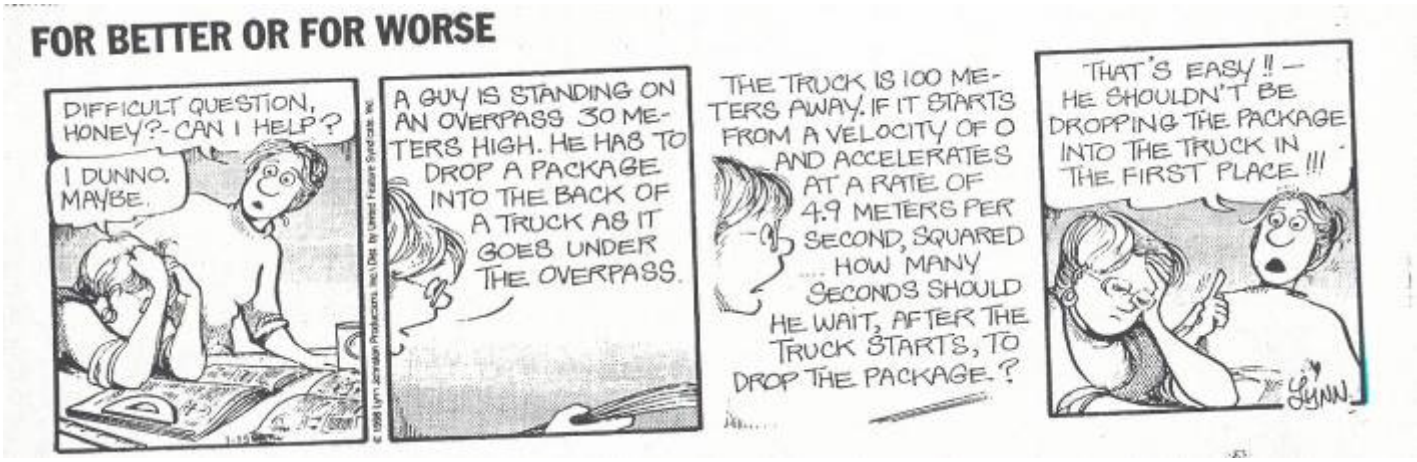
Physics Traditional 1314 Williams

Free Fallin'

Chapter 2



One-dimensional "Nifty" equations of motion

Equation	a	t	v_i	v_f	Δx
$\Delta x = \frac{(v_i + v_f)}{2} t$	☹	√	√	√	√
$v_f^2 = v_i^2 + 2a\Delta x$	√	☹	√	√	√
$\Delta x = v_i t + \frac{1}{2}at^2$	√	√	√	☹	√
$v_f = v_i + at$	√	√	√	√	☹

Assumptions you need to know (write these in your notebook and commit them to memory!)

1. $g = -9.8\ m/s^2$ (you're on earth unless the problem specifically says differently)
2. $v_i = 0$ for any object dropped or thrown horizontally
3. symmetry: same time up as down, same speed up as down, same height up as down
4. object tossed upward: v = 0 at highest point, acceleration never changes or "stops"
5. easiest to use downward flight + symmetry to find time airborne

Find: Sad face, equation to use & practice assumptions

1. A cart is pushed down a ramp. It begins going 2.5 m/s and 5 seconds later its going 6.5 m/s. How fast is it accelerating?

2. A cart is pushed down a 20 m long ramp where it accelerates uniformly. It goes from 0 to 3 m/s while covering its distance. How long did this take?

3. A ball is released from a 1.6 m above the floor and allowed to fall. How long did it take to reach the floor?

4. A ball is released from a 1.6 m above the floor and allowed to fall. How fast was it going at impact?

5. How deep is a well if it takes 1.5 seconds for a stone to fall to the bottom?

6. You throw a stone downward at 20 m/s. How long will it take to reach 30 m/s?

7. 30.5 m is 100 ft. How fast do you need to throw a ball to make it go 100 ft into the air?

8. How long will the ball in the previous problem be airborne? (hint: use $\Delta x = -30.5$ m)

Physics - Quick Practice

1. a, t, v_i, v_f and Δx

Maya releases a ball where it freefalls to the floor 0.45 sec later. How fast was it going when it struck the floor?

2. a, t, v_i, v_f and Δx

Ooglabaroopa is visiting another unfortunate planet, Zord. If she drops a Zordian into a 15 m deep processing tunnel and it takes him 1.8 seconds to reach bottom, what is the final velocity of the Zordian?

3.

Kevin throws a ball upward with a speed 19.6 m/s and 4 seconds later catches it. How high did the ball go?

4.

Bri jumps downward with an initial velocity of -5 m/s. She strikes the water below with a speed of 29.6 m/s. How far from water is she at the start?

5.

Spock logically needs to find the depth of a Klingon crater. He drops a meteorite from rest where and uses a radar to find it strikes the crater bottom 2.5 seconds later with a velocity of -12.5 m/s. How deep is the crater?

6.

Delaney tosses a basketball straight up from an initial height of 2 m with a speed of 4 m/s. How long will it take for the ball to reach the floor?

7.

Mike points his dart gun down a 15 m tube and shoots. The initial dart velocity is -12 m/s. How long will the dart take to reach the end of the tube?

8.

Ben is practicing for the juggling Olympics. So far he can juggle one at a time and he's hoping to try two really soon. How fast does he have to toss a tennis ball into the air to have 0.30 seconds? (Hint: it will take 0.15 sec to go up and 0.15 sec to go down….think about it!)

Name:_____

Hang Time Lab

Purpose: The purpose of this lab is to determine **YOUR** personal hang time using the kinematic equations (TNEOM).

Procedure:

1. Find a place in the hallway where you can determine your maximum vertical leap. If you are able to jump and hit the ceiling, you probably want to go further down the science wing where the ceiling is higher so you don't hit the ceiling tiles and possibly cut your hand! (It's happened before!)
2. Jump as high as you can against a wall. Your partner will observe and place his/her meter stick at the high point.
3. Straightening out the meter stick to vertical while keeping the high point as the meter stick end-point, see how high you can reach on the meter stick while feet are flat.
4. The difference between the meter stick value without jumping and the jumping high point is your "vertical". Record this value in centimeters.
5. Use your clever brain to calculate your personal hang time (the amount of time you are airborne). Be careful to carefully consider this calculation as there are two common mistakes students often make.
6. Show your work below and hand in for credit. USE 4 STEPS! Failure to do so will result in less than full credit.

Data / Calculations:

My vertical is _____ cm My hang time is _____sec.

Name:_____

Reaction Time Mini-Lab: Do You Know Kung-Fu?

Purpose: The purpose of this lab is to accurately measure your reaction time using the acceleration due to gravity.

Materials: Ruler (metric)

Procedure:

1. Have your lab partner hold a ruler between your fingers. To be fair, keep your fingers about an inch a part.
2. Without warning, have your partner drop the ruler and attempt to catch it as quickly as you can between your fingers (reaction time!).
3. Record your data below.
4. Using your average catching distance, calculate your reaction time below. Show ALL work (4 STEPS!).
5. Write a short conclusion on the back side of this page by answering the following questions: How does your reaction time compare to that of the average human reaction time of 0.14 seconds? What if you could speed up your reaction time or slow down the reaction time of other people—how would that affect a sport you like to play or what could you get away with that you normally wouldn't be able to do? Is hang time used for this calculation, why/why not?

Trial	Distance (cm)
1.	
2.	
3.	
4.	
5.	
Average	

Work:

My reaction time is: _____ seconds

Reaction time lab conclusion (couple sentences each will do)

1. How does your reaction time compare to that of the average human reaction time of 0.14 seconds?

2. What if you could speed up your reaction time or slow down the reaction time of other people—how would that affect a sport you like to play or what could you get away with that you normally wouldn't be able to do?

3. Is hang time used for this calculation, why/why not?

Quick drills…List all knowns & unknowns to find sad face!

1. What acceleration would you have on a planet where it takes 3.5 seconds for a dropped rock to go from rest to 70 m/s?

2. On planet zepton, a zeptonian measures velocity change from -3.0 m/s to -27.0 m/s while dropping a distance of 45 m. How long did it take for this freefall to occur?

3. Scott throws a rock downward off of a cliff. Scott's initial velocity was -15 m/s and it took 2.5 seconds to reach the bottom below the cliff. How far is the cliff from the ground below?

4. Didi tosses a basketball downward with a speed of 10 m/s to her friend Gabby directly below. Gabby is on the ground floor which is 12 m beneath the railing Didi is leaning on. What is the velocity of the ball at the time her Gabby catches it?

Physics - Quick Practice

9. a, t, v_i, v_f and Δx

Davis releases a ball where it freefalls to the floor 0.45 sec later. How fast was it going when it struck the floor?

10. a, t, v_i, v_f and Δx

Ooglabaroopa is visiting another unfortunate planet, Zord. If she drops a Zordian into a 15 m deep processing tunnel and it takes him 1.8 seconds to reach bottom, what is the final velocity of the Zordian?

11.

Brody throws a ball upward with a speed 19.6 m/s and 4 seconds later catches it. How high did the ball go?

12.

Kelsey jumps downward with an initial velocity of -5 m/s. She strikes the water below with a speed of 29.6 m/s. How far from water is she at the start?

13.

Spock logically needs to find the depth of a Klingon crater. He drops a meteorite from rest where and uses a radar to find it strikes the crater bottom 2.5 seconds later with a velocity of -12.5 m/s. How deep is the crater?

14.

Maddie tosses a basketball straight up from an initial height of 2 m with a speed of 4 m/s. How long will it take for the ball to reach the floor?

15.

Christian points his dart gun down a 15 m tube and shoots. The initial dart velocity is -12 m/s. How long will the dart take to reach the end of the tube?

16.

Mr. Williams is practicing for the juggling Olympics. So far he can juggle one at a time and he's hoping to try two really soon. How fast does he have to toss a tennis ball into the air to have 0.30 seconds? (Hint: it will take 0.15 sec to go up and 0.15 sec to go down….think about it!)

Unit 02 – Vocabulary and Equations – Freefall

Vocabulary:
previous vocabulary
$g = -9.8\ m/s^2$ (memorize this value!)
freefall
terminal velocity
air resistance
drag
hang time
up down
down time
reaction time
anticipation
reaction

Symbols:
Δ, x, v, t, Δx, Δv, Δt, a, f, i

Equations & constants:
You get these on test:

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t}$$

$$\Delta x = v_0 \Delta t + \tfrac{1}{2} a t^2$$

$$v = v_0 + a \Delta t \quad (v \text{ means } v_f)$$

$$v_f^2 = v_i^2 + 2a \Delta x$$

60 mph = 27 m/s; 60 seconds = 1 min.; 60 min = 1hr.

Unit Objectives - Williams
1. I understand all the vocabulary & math of this unit and all demos, videos, equations, and class assignments.
2. I remember objectives & vocabulary from previous units.
3. I have memorized g, the acceleration of gravity on earth's surface including the units
4. I understand what freefall is and can contrast it with terminal velocity
5. I know hang time and that it includes time for both the upward and downward motions of airborne object
6. I understand what g is and realize that g is a constant negative value, it does NOT become zero at the high point or switch signs on the way down
7. I understand motion graphs related to freefall, terminal velocity, reaction time and other topics in this unit
8. I can look at physics problems and know what assumptions to use to solve them including when v = 0 and the concept of symmetry
9. I know when to double the time (hang time) and when not to (reaction time)
10. I remember the objectives from the previous unit since they still apply to this unit!
11. I can apply one-dimensional motion equations and TNEOM to solve freefall and hangtime problems

DuPage ROE Objectives
101. I can distinguish between scalar and vector quantities.
102. I can differentiate between accelerated and constant velocity motion.
103. I can describe and analyze motion based on graphs, numeric data, words, and diagrams.
104. I can differentiate between speeding up, slowing down, and change in direction, based on the direction of velocity and acceleration.
107. I can justify that if the only force acting on an object is gravity, it will have the same constant downward acceleration regardless of mass, velocity or position.

Equation	a	*t*	v_i	v_f	Δx
$\Delta x = \frac{(v_i + v_f)}{2} t$	☹	√	√	√	√
$v_f^2 = v_i^2 + 2a\Delta x$	√	☹	√	√	√
$\Delta x = v_i t + \frac{1}{2} a t^2$	√	√	√	☹	√
$v_f = v_i + at$	√	√	√	√	☹

Physics Calendar - Freefall: 2013-14(Williams) - Chapter 2 (7 days)

Bold and underlined means put in journal notes (for any problems: Show your work!);

1	**Mo:09/09/13**	GOALS: Go over test, Freefall vs. Terminal Velocity, Intro Nifty (TNEOM), Quick drills & solve • Go over test if 98% took it, rules on late journal • Montage & Freefall/Terminal V. intro discussion • Go over Nifty organization vs. equations you get to use • Quick drills & solve a couple all the way (p. 3 pkt, p. 2?)	• **(02-01)** Freefall vs. terminal velocity notes, 1d Nifty (TNEOM)**:3,4,5,6,7,8,9, 11**
2	**Tu:09/10/13**	GOALS: Notes check, assumptions mastery, graph interp. • 10 min max notes recap, then notes quiz • Clickers or group quiz (graph interp, TV/FF, etc.)	• **(02-02)** Read chapter 2, section 3 in your book and take notes
3L	**We:09/11/13**	GOALS: Hang time lab • Clix, Preview HW problems • Do lab and start HW if time (copies of HW, or on board) • Turn in when done (2 per group for any group of 5 or 6)	• **(02-03)** p. 64: 1-4 • **(02-04)** p. 65: 1-6
4	**Th:09/12/13**	GOALS: Reaction time lab • Clix, Take HW Q's/preview HW • Do lab and start HW if time (copies of HW, or on board) • Turn in when done (2 per group for any group of 5 or 6)	• **(02-05)** p. 68: 1, 5, 17, 14, 21, 30
5	**Fr:09/13/13**	GOALS: Freefall and TV graphs & behaviors • Terminal velocity of coffee filter (tracker demo), show graphical shapes • Discuss slopes/shapes of TV/FF • Discuss horizontal acceleration (ramps, cars, etc. (a isn't "always 9.8"!)) • Group quiz on above/HW time	• **(02-06)** p. 68: 4, 8, 10, 18, 23, 31, 32
6	**Mo:09/16/13**	GOALS: • Clix, Take HW Q's/preview HW • Quick drills and/or group quiz • Start HW/Review of any kind class chooses	• Study for test
7	**Tu:09/17/13**	• Test: Freefall. Chapter 2	• Call or visit a friend instead of using instant messages or texting